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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/625,483	07/22/2003	Andreas Hilliger	14580-020001	9125

20985 7590 05/06/2005

FISH & RICHARDSON, PC
12390 EL CAMINO REAL
SAN DIEGO, CA 92130-2081

EXAMINER

SEFER, AHMED N

ART UNIT PAPER NUMBER

2826

DATE MAILED: 05/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

ETC

Office Action Summary	Application No. 10/625,483	Applicant(s) HILLIGER ET AL.	
	Examiner A. Sefer	Art Unit 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 February 2005.
 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
 4a) Of the above claim(s) 11-18 is/are withdrawn from consideration.
 5) ☐ Claim(s) _____ is/are allowed.
 6) ☒ Claim(s) 1-10, 19 and 20 is/are rejected.
 7) ☐ Claim(s) _____ is/are objected to.
 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>2/2005</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. The amendment filed 2/18/2005 has been entered and new claims 19 and 20 have been added.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 20 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The application as originally filed does not specifically support the claim limitation “wet etching the contact hole after forming the contact hole barrier layer”. The specification merely discloses that the barrier was etched on its lower surface to remove a portion indicated as 13 on the bottom surface of the contact well (see page 9, lines 24-27).

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this

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subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1, 3, 6 and 7 are rejected under 35 U.S.C. 102(e) as being anticipated by Nguyen et al. ("Nguyen") USPN 6,878,620.

Nguyen discloses (figs. 1-2, col. 4, lines 7-15 and abstract) a method of forming a contact to an underlayer or region of a device or semiconductor device (as in claim 7) comprising forming a contact hole 110/210 through a portion of the device including a first contact hole barrier layer 106/206, the contact hole having sides which extend above and below the first barrier layer and having a bottom surface; forming a contact hole barrier layer 112/212 of a barrier material in the contact hole deposited using ALD method (as in claim 6), the contact hole barrier layer being continuous between the sides and bottom surface of the contact hole; etching the contact hole barrier layer on the bottom of the contact hole surface (figs. 1d and 2d); depositing a liner material 220 in the contact hole to form a contact a contact liner to promote subsequent filling of the contact hole; and filling the contact hole with a conductive material 222.

Regarding claim 3, Nguyen discloses (col. 3, lines 51-65) a wet etching step, the contact hole barrier layer being formed before the wet etching step.

6. Claim 20, as understood, is rejected under 35 U.S.C. 102(e) as being anticipated by Nguyen.

Nguyen discloses (figs. 1-2, col. 4, lines 7-15 and lines 53-60 and abstract) a method of forming a contact to an underlayer or region of a device comprising forming a contact hole 110/210; forming a contact hole barrier layer 106/206 of a barrier material in the contact hole; wet etching the contact hole after forming the contact hole barrier layer (col. 4, lines 53-60); thickening the contact hole barrier layer by application of a second contact hole barrier layer

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114/214; etching the contact hole barrier layer on the bottom surface of the contact hole; depositing a liner material 220 in the contact hole to form a contact a contact liner to promote subsequent filling of the contact hole; and filling the contact hole with a conductive material 222.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen in view of Lee ("Lee") US PG-Pub 2004/0102035.

Nguyen discloses a method of forming a contact to an underlayer as recited in the claim, but does not disclose a contact hole barrier being formed after a wet etch step.

Lee discloses in figs. 3-6 a method of forming a contact to an underlayer or region of a device comprising forming a contact hole extending through a portion of the device including a first barrier layer 205, the method including a wet etch step, a contact hole barrier layer 180 being formed after the wet etch step and filling voids in the first barrier layer caused by the wet etch step.

Therefore, it would have been obvious to one skilled in the art at the time the invention was made to incorporate Lee's teachings with Nguyen's method of forming a contact to an underlayer since that would minimize problems associated with electro- stress-migration as taught by Lee.

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9. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen in view of Lee as applied to claims 1 and 3 above, and further in view of Kim et al. ("Kim") US PG-Pub 2003/0160333.

The combined references disclose a thickened barrier layer by application of a second contact hole barrier layer 114/214 (figs. 1 and 2 of Nguyen), but do not specifically disclose thickening of the contact hole barrier following a wet etch step.

Kim disclose (figs. 7-9 and par. 0022) a method of forming a contact to an underlayer including thickening of a contact hole barrier 32/34 following a wet etch step exposing interconnection layer 20.

Therefore, it would have been obvious to one skilled in the art at the time the invention was made to incorporate Kim's teachings since that would provide a low contact resistance as taught by Kim.

10. Claims 5 and 7-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen in view of Morozumi ("Morozumi") US PG-Pub 2003/0098466.

Nguyen discloses a method of forming a contact to an underlayer as recited in the claim, but does not disclose an alumina/TiO₂ barrier.

Morozumi discloses (see fig. 4, abstract and par. 0099) a method of forming a contact to an underlayer or region a semiconductor (as in claim 7), a passive (as in claim 8), a capacitor (as in claim 9) or a FeRam (as in claim 10) device including an alumina barrier.

Therefore, it would have been obvious to one skilled in the art at the time the invention was made to incorporate Kim's teachings with Nguyen's method of forming a contact to an underlayer since that would shut off hydrogen as taught by Morozumi.

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11. Claim 19 is rejected under 35 U.S.C. 102(e) as being anticipated by Nguyen in view of Kim.

Nguyen discloses (figs. 1-2, col. 4, lines 7-15 and lines 53-60 and abstract) a method of forming a contact to an underlayer or region of a device comprising forming a contact hole 110/210 through a portion of the device including a first contact hole barrier layer 106/206, the contact hole having sides which extend above and below the first barrier layer and having a bottom surface; forming a contact hole barrier layer 112/212 of a barrier material in the contact hole; etching the contact hole barrier layer on the bottom of the contact hole surface (figs. 1d and 2d); depositing a liner material 220 in the contact hole to form a contact a contact liner to promote subsequent filling of the contact hole; and filling the contact hole with a conductive material 222, but does not specifically disclose forming the contact hole barrier after wet etching the contact hole.

Kim disclose (figs. 7-9 and par. 0022) a method of forming a contact to an underlayer including thickening of a contact hole barrier 32/34 following a wet etch step exposing interconnection layer 20.

Therefore, it would have been obvious to one skilled in the art at the time the invention was made to incorporate Kim's teachings since that would provide a low contact resistance as taught by Kim.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. May et al. US PG-Pub 2005/0064708 discloses (see par. 0030) an interconnection

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structure including a contact hole barrier layer or a multi-layered contact hole barrier layer having etched bottom surface.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to A. Sefer whose telephone number is (571) 272-1921

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (571) 272-1915.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ANS

April 28, 2005


NATHAN J. FLYNN
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